JPRS 75430

2 April 1980

USSR Report

SPACE

No. 4

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I. MANNED MISSION HIGHLIGHTS

'TASS' REPORTS ON 'SALYUT-6--SOYUZ-T' MISSION

Orbital Parameters Provided

Moscow TASS in English 1115 GMT 29 Feb 80

[Abstract] As the flight of the "Salyut-6--Soyuz-T" space complex continues, both the station's on-board systems and the modified transport ship's systems are being tested in accordance with the planned flight program. Parameters for the orbiting complex are as follows:

--apogee, 369 km;

--perigee, 343 km;

--orbital period, 91.5 min;

--orbital inclination, 51.6°.

All flight systems are functioning normally.

'Soyuz-T' Undocked

Moscow TASS in English 0954 GMT 24 Mar 80

[Abstract] The "Soyuz-T" transport ship was undocked from the "Salyut-6" station at 0004 hours Moscow time on 24 March 1980. Final testing of the "Soyuz-T" propulsion systems and orientation and control systems will be conducted as the vehicle continues in an automatic flight mode.

"Salyut-6" orbital parameters are as follows:

--apogee, 363 km;

--perigee, 344 km;

--period, 91.4 min;

--inclination, 51.6°.

'Soyuz-T' Soft Lands

Moscow TASS in English 0928 GMT 26 Mar 80

[Abstract] The "Soyuz-T" landing module made a controlled descent and soft landing over Soviet territory on 26 March. The landing marked the end of 100 days of flight testing, which included docking with the "Salyut-6" space station, adjusting new on-board systems, checking various new equipment and correcting flight trajectories of the complex. All on-board systems and equipment operated faultlessly throughout the trials, thus signifying "a further step along the road of the development and perfection of Soviet space technology."

[251-P]

COSMONAUT REVEALS SOVIET INTENTIONS FOR USE OF SOYUZ-T

Paris AIR & COSMOS in French No 800, 16 Feb 80 pp 50-51

[Article by Pierre Langereux: "New Revelations About the Soyuz-T Vehicle"]

[Editorial Report] Soviet cosmonaut Petr Klimuk revealed in an interview with AIR & COSMOS correspondent Pierre Langereux some new information about the Soyuz-T transport ship and Soviet intentions for its use as part of the total Salyut-Soyuz system.

First he noted that Soyuz-T has been designed to serve as either a freight transport ship or as a manned transport carrying two cosmonauts, "as has become the rule on Soviet transport vehicles."

Emphasizing that "in the immediate future Soyuz-T will not totally replace" the conventional Soyuz, Klimuk indicated that the USSR will continue to make use of all three types of transport ships at its disposal: Progress, Soyuz and Soyuz-T. The new Soyuz-T could be piloted by an all-Soviet crew only whereas the conventional Soyuz, in which the role of "pilot" is rather limited, will continue to fly international crews. The reason for maintaining this duality, according to Klimuk, lies in the time necessary to train cosmonauts to fly Soyuz-T: at least 1 year's training with the flight simulator will be required (and Klimuk, an experienced cosmonaut, said that it took him about 1 1/2 years to master the new vehicle).

Soyuz-T incorporates some very clear improvements over the conventional Soyuz ship although its exterior design and total mass have been changed relatively little. According to Klimuk, the two most insignificant improvements are in piloting the vehicle (thanks to an on-board digital computer which processes all flight operations data and displays them on a single screen) and in the ship's maneuvering capabilities (thanks, in large part, to the unified propulsion system similar to that of the second generation Salyut station).

Klimuk also revealed that the ship's autonomous flight mode was improved with "the possibility of equipping the new vehicle with solar panels." In saying that the use of solar panels was not for the present foreseen because the transport ship could rely on energy provided by the Salyut-6 station, he contradicted earlier comments made by former cosmonaut and chief Salyut designer Konstantin Feoktistov, who had indicated to Soviet central press correspondents that Soyuz-T was now equipped with two solar "wings" [see IZVESTIYA 21 Dec 79 p 6, PRAVDA 20 Dec 79 p 6 and TRUD 20 Dec 79 p 6 reported in JPRS 75111].

Klimuk confirmed Soviet reports that the Salyut-6 station can be used again, explaining that a new crew would soon be launched, but he noted that as of the date of the interview (1 February) there was no crew at Baykonur.

[229-P]

SOVIETS PLAN ONE-YEAR MANNED MISSION

Paris AIR & COSMOS in French No 799, 9 Feb 80 p 5

[Editorial Report] A news brief published in AIR & COSMOS notes that during a visit to France, Soviet cosmonaut Petr Klimuk revealed that the Soviets are now planning a manned mission of 1 year's duration.

[219-P]

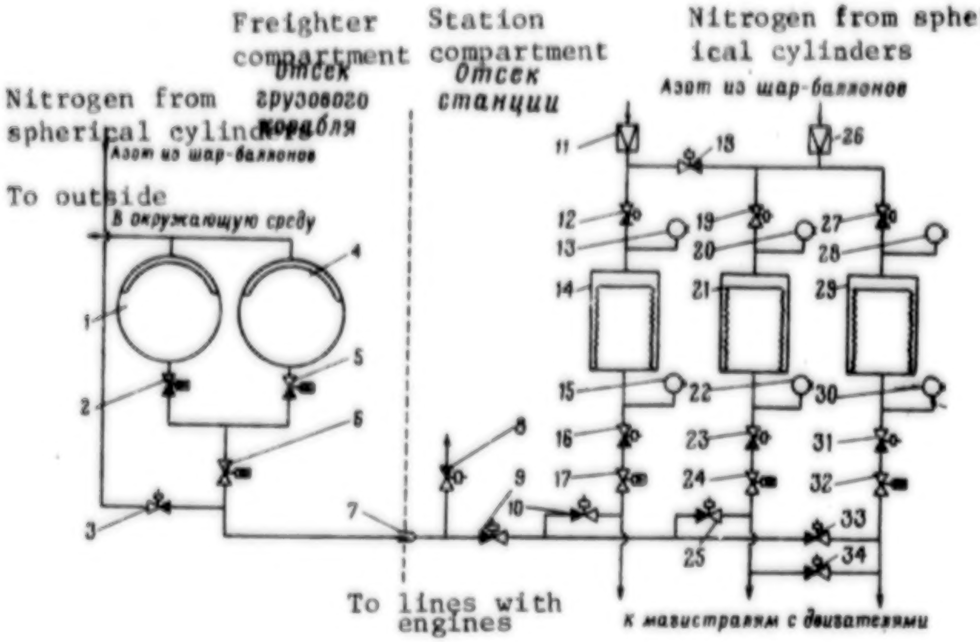
MALFUNCTIONING OF 'SALYUT-6' FUEL SYSTEM DISCUSSED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 11, 1979 pp 34-35

[Article by E. Grigorov and N. Pavlov, "Using Terrestrial Analogues"]

[Abstract] Near the end of their "Salyut-6" station operations, cosmonauts Kovalenok and Ivanchenkov noted deviations in the control parameters for the fuel lines. These deviations were detected by sensors 13, 15, 20, 22, 28 and 30, indicated in the figure. These sensors indicated a break in the membrane in fuel tank 29, which threatened a malfunctioning of the non-metallic packings of valve 27 (already discussed in AVIATSIYA I KOSMONAVTIKA, No 6, 1979, pp 43-44; [see JPRS 73852, USSR REPORT: GEOPHYSICS, ASTRONOMY AND SPACE, No 449, 17 Jul 79 pp 36-41]). It was decided to combine the fuel in the two properly operating tanks into the one tank 14, freeing tank 21 to receive fuel from tank 29. In order to prevent mixing gas together with fuel in tank 21, prior to transfer the space complex was rotated to separate the gas from fluid by means of centrifugal forces. Most of the fuel was transferred into the properly functioning station tank and the remainder into the "Progress" tanks. On 14 March 1979, with a new crew aboard, "Progress-5" was docked to the station to participate in repair work, which began the next day. The "Salyut-6"--"Soyuz-32"--"Progress-5" complex was

rotated about its transverse axis. Then the fuel from tank 21 was transferred into tank 14, and from tank 29 into tank 21. Fuel from tank 29 was pumped into tanks 1 and 4 of the "Progress" ship, after which tank 29 was vented to space. The opening and closing of valves was done by the crew and monitored at the Flight Control Center. Over a period of 7 days the malfunctioning tank was vacuumed. On 23 March nitrogen was fed into the tank. Valve 3 was closed and valve 8 was opened so that the tank would vent to space. This operation was accomplished several times for complete elimination of fuel traces. For 4 days the tank was connected to the vacuum. Valve 27 was opened for cleaning the supercharging line. On 27 March the tank was again "flushed" with nitrogen. Then it was filled with nitrogen and remained in that state. Closing valve 32, the tank was finally cut off from the fuel system. As a result, the engine complex had two fuel tanks and performance was maintained.



Elements of pneumohydraulic system of combined engine on "Salyut-6" station and fuel compartment of "Progress" freighter: 1, 4, 14, 21, 29--fuel tanks; 2, 5--closed pyrovalves; 3, 8, 9, 10, 12, 16, 18, 19, 23, 25, 27, 31, 33, 34--electric valves; 6, 17, 24, 32--open pyrovalves; 7--telescopic connection of lines; 11, 26--reducers in lines for supercharging tanks; 13, 15, 20, 22, 28, 30--pressure sensors. Figures 1.

[91-5303]

TOOLS USED IN SPACE DESCRIBED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 2, 1980 pp 30-31

[Article by Engineers B. Kryuchkov and N. Fefelof: "Space Tools"]

[Text] The "Salyut-6" scientific station is now working for the 3rd year in space. Cosmonauts carried out research for 407 days aboard this station. Seven "Progress" freight transport ships regularly supplied them with necessary materials, interchangeable equipment units, apparatus and fuel. The "Salyut-6" orbital station is continuing flight in an automatic regime.

Reliable functioning of station systems was ensured by both duplication of a number of units and by repair and preventive maintenance work which is carried out by the crew. In the course of technical servicing of the station the cosmonauts employed special tools. A set of these tools makes it possible to perform the widest variety of preventive maintenance and repair tasks. It goes without saying that the need for tools has not arisen in all cases. As is well known, a considerable part of the station equipment is easily installed and removed manually. This is accomplished through the use of a special fastening in the form of a wing-nut, thumbscrew, "gramophone" or spherical lock. In some cases malfunctions are completely eliminated without disassembling equipment, but by using the control devices on a particular instrument or unit. Such operations were performed, for example, when checking the hermetic sealing of the ShK-1 airlock.

All tools aboard the orbital station can be divided into two groups. One group includes sets of screwdrivers and wrenches, an adjustable wrench, shears, knife, pliers, awl and nipper. These are so-called "most-needed" tools. They are kept in the vicinity of the main control post on the station not far from the crew commander's seat.

The "less-needed" set includes some wrenches, "keys" for electric plugs, adapters and caps, flanges--tools for work outside the station. This set is rarely used. It is stored in the living area near the equipment bay.

Naturally, for repair and preventive maintenance insulating and adhesive tapes, wire, straps, glue, filaments, lubricants, Kapron and rubber lines, lamps and fuses can be required. All this in the necessary quantities is kept aboard the orbital station.

The sets of tools can be supplemented by various additional devices depending on the flight program. For example, for the operations which G. Grechko and Yu. Romanenko performed in open space, the designers prepared special devices in advance. A lamp was prepared for illumination (in orbit day lasts only about 45 minutes and not much can be done during that time; it is also necessary to work "at night"). The crew took along a template for checking the guide pins for the electric plugs in the docking unit. They also wore safety lines; without this equipment they could "float off" into open space.

What requirements are imposed on space tools? In particular, they must correspond to man's functional capabilities and must ensure a high productivity of labor with minimum energy expenditures. In creating a tool its universality must be achieved, that is, it must be able to perform several operations. Typical in this respect is a multipurpose recoilless electric drive with attachments for screwing and unscrewing screws, cutting metal and removing edges and with a universal drill for drilling openings of different diameter. Its design is conditioned by size and weight restrictions in the space vehicle. The number of types and sizes of fastenings is also limited. We note in passing that the tool, in combination with fastenings, constitutes a unified, easily assembled system, the coaxiality of whose elements is ensured by design without additional efforts and checking.

An important requirement on space tools is that they be free of recoil during use. For example, the hammer,in contrast to its terrestrial analogue, has within it a cavity which is filled with small spheres. Upon impact there is virtually no recoil because the small spheres dissipate the recoil energy. The "anchor" screwdrivers also have an unusual design; outwardly they are similar to socket wrenches. When such a screwdriver is fitted onto a screw, the spheres of a special lock enter into its recesses on the cylindrical head. The cosmonaut need only turn a control lever, the lock locks and the screw together with the tool is transformed into a rigidly coupled system. Work with such a screwdriver requires less effort and time than when working with an ordinary terrestrial screwdriver.

The conditions for man's work in a state of weightlessness are extremely unusual. Therefore the designers have provided different devices that facilitate use of the tools. For example, with a safety belt the cosmonaut can fix himself in virtually any point in the living compartment of the station and assume a posture unthinkable under terrestrial conditions (for example, parallel to the compartment floor). As a result, the servicing area is considerably increased and the man has support. Turning the tool, he himself remains fixed in position. The safety belt has pockets for storing the tool and fastenings. The latter can also be placed in special holders or clips.

Another such device is a bracelet with a chain and latch hook. It is necessary for holding the tool if it is accidentally dropped in the work process. The repair of small parts can also be accomplished using a vise.

Do the cosmonauts require special training for work with the tools carried aboard the "Salyut-6" station? Only an affirmative answer can be given to this question. The cosmonaut must definitely know what tool is used where, have a good idea about how to conveniently approach the units to attach instruments and be skilled in carrying out operations for the assembly and disassembly of lines with liquid and gas components. If precautionary measures are not observed, such components can enter the living compartment's atmosphere. Finally, it is necessary to learn to work with the tools so that under weightlessness conditions there is no damage to the instrument and the cosmonaut does not harm himself.

At the Cosmonaut Training Center imeni Yu. A. Gagarin exercises with on-board tools are carried out in the orbital station simulator. First the crew becomes familiar with the variety of tools and where they are kept. Then they begin training in assembly-disassembly and repair-restoration work. They practice the sequence for replacing units, acquire skills in using the tool and, on a practical basis, study the technical servicing instructions. We will illustrate this with the example of replacing a regenerator in the system for maintaining the gas composition in the station atmosphere which had reached the end of its useful lifetime.

First the cosmonaut precisely determines the time necessary for the particular operation and agrees with the Flight Control Center on the time to begin work. Then he examines the instructions and prepares the work place; he selects the necessary tool from the set and secures it, puts on a safety belt and the bracelet, removes and secures the decorative panels in the interior, disconnects the current from the fans and disconnects the air supply hose. With a wrench or screwdriver he removes the parts holding the regenerator. The fasteners are put into the pockets on the belt. The disassembled unit is transported by the cosmonaut into the area where it is to be stored temporarily and he replaces it with a new unit.

Although this operation cannot be regarded as complex, it requires definite skills in handling tools under weightlessness conditions.

One of the important stages in training crews for working with on-board tools is practicing with them aboard a "Salyut" station being prepared for flight. The exercise is carried out in the factory when the assembly of equipment has already been in large part completed. In one of these training sessions V. Kovalenok proposed the fabrication of a special screwdriver for working with the water regeneration system. Specialists approved his proposal and the screwdriver was included in the set of on-board tools. Vladimir Vasilyevich himself became its first "tester" in space flight.

Can a cosmonaut, clad in a spacesuit under excess pressure, work with a wrench, screwdriver or some other tool? Yes, he can. This was convincingly demonstrated by the cosmonauts Yu. Romanenko, G. Grechko, V. Lyakhov and V. Ryumin. For example, Valeriy Ryumin in a spacesuit emerged into open space, "walked" on the outside along the entire station, cut four cables with nippers, and then with a special lever removed the antenna of the KRT-10 radiotelescope and thereby ensuring further operation of the orbital station in accordance with the planned flight program.

Georgiy Grechko worked for 1 hour 28 minutes in open space. During this time he inspected the end and shell of the docking unit, antennas, signal lights and solar cells and with a special template checked the good working order of the electrical docking plugs. And when Grechko's voice was heard at the Flight Control Center: "The conditions in the spacesuit are comfortable. The tool is excellent. The electric plug is in good working order," everyone understood that still another step had been taken in the mastery of space technology.

Each flight of crews aboard the "Salyut" stations opens up new possibilities for improving on-board instrumentation and equipment, including the tools to be employed in carrying out repair and preventive maintenance work.

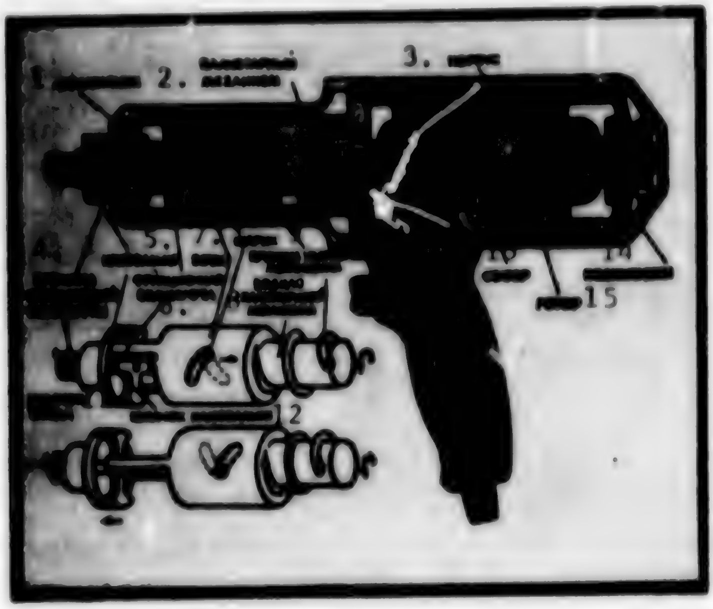


Figure 1: Design of space electric drill.

Key:

1. Bearing
2. Planetary mechanism
3. Housing
4. Spring of friction semiclutch
5. Anvil
6. Friction semiclutch
7. Striker
8. Planetary mechanism guide
9. Sphere
10. Spring of impact mechanism
11. Striker cam
12. Anvil cam
13. Stator
14. Bearing
15. Rotor

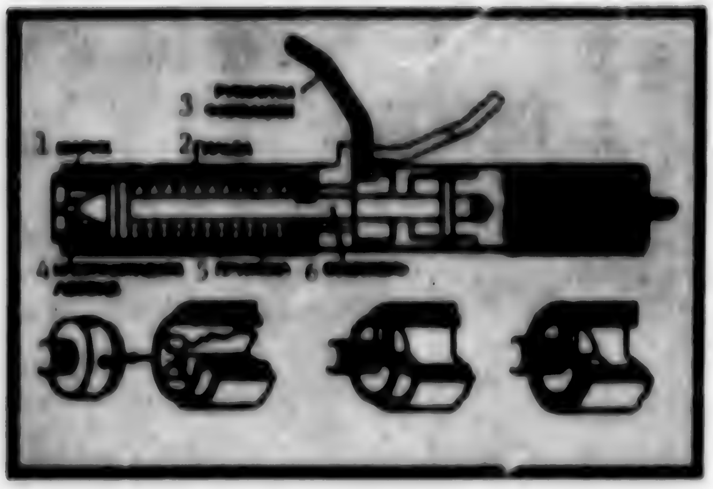


Figure 2: Space screwdriver.

Key:

1. Sphere
2 Case
3. Clamping lever
4. Cross-shaped blade
5. Spring
6. Shaft

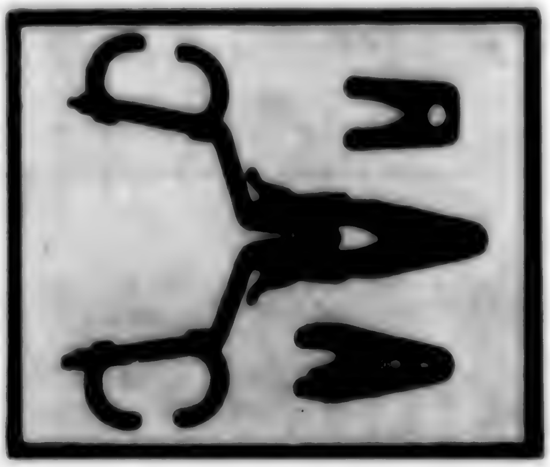


Figure 3: General-purpose lever-type tool with attachments in form of nippers, shears and common pliers.

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II. SPACE SCIENCES

PARAMETERS OF PROTONS IN RELATION TO VELOCITY OF SOLAR WIND

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 17 No 6, 1979 pp 901-905

[Article by Yu. V. Mineyev, I.A. Savenko and Ye. S. Spir'kova: "Fluxes and Anisotropy of Protons in January-February 1974 and Their Relationship to Solar Wind Velocity According to Data From the 'Mars-7' Automatic Interplanetary Station"]

[Abstract] The parameters of proton streams and their relation to the velocity of the solar wind were studied for the period January-February 1974 on the basis of data from the "Mars-7" automatic interplanetary station. This paper presents experimental results obtained at great distances from the earth, up to 2.4 a.u. Figure 1 in the text shows the changes in streams of protons with an energy 1-150, 3-35 MeV, their anisotropy and solar wind velocity in January 1974. Figure 2 shows the changes in streams of protons in February 1974. Since the station had covered a considerable distance, it was possible to measure the anisotropy of the streams; this is shown graphically. In the flight through quiet background sectors of the interplanetary medium there was a stable negative anisotropy for streams of protons E_p = 1-150 MeV, constituting from - 10 to - 20 percent; in these same sectors the anisotropy for streams of protons E_p = 3-35 MeV is positive and varies from ~ 10 to ~ 20 percent. Similar data were obtained for other distances and conditions. These data are compared with measurements made by "Explorer-43" and "Pioneer-11." It appears that the shock waves which are formed with an increase in steepness of waves in the solar wind form low-energy protons. It is possible that the protons detected at the earth are created in their entirety by such shock waves and at great distances from the sun are modulated by magnetic fields associated with the solar wind. Figures 2; references 8: 5 Russian, 3 Western.

[136-5303]

DISTRIBUTIONS OF ELECTRON EVENTS ASSOCIATED WITH SOLAR FLARES

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 17 No 6, 1979 pp 906-912

[Article by M.N. Belovskiy, Viktoriya G. Kurt and Yu. P. Ochelkov: "Features of Intensity Distribution of Electron Events Associated With Solar Flares"]

[Abstract] A study was made of the distribution of electron events associated with solar flares with respect to intensity at the maximum, and a comparison is made with the distribution functions for X-ray and microwave bursts. It is shown that the distribution of electron events (for nonrelativistic electrons) with respect to intensity is a power-law distribution with an exponent close to the exponent for the distribution functions for microwave and X-ray bursts. The existence of a power-law form of distribution functions is determined by the power-law form of distribution of flares with respect to the number of electrons accelerated in a flare. It is demonstrated that the distribution of flares by number of accelerated relativistic electrons is close to the distribution of flares with respect to the number of accelerated protons ($E_p > 10$MeV) and is substantially different from the distribution of events with respect to the number of accelerated nonrelativistic electrons. The intensity of the relativistic electrons observed near the earth is closely associated with the intensity of the protons; the correlation coefficient is $\rho = 0.88$. At the same time, the correlation of the streams of nonrelativistic electrons and protons is considerably lower ($\rho = 0.72$). The determined patterns in the intensity distribution of events as well as a comparison of the observed streams of electrons and protons support the hypothesis that in many flares the process of acceleration of nonrelativistic electrons is different from the process of acceleration of relativistic electrons and protons. Figures 5, tables 2; references 17: 5 Russian; 12 Western.

[136-5303]

EXCESS RADIATION OF COSMIC RAYS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 17 No 6, 1979 pp 913-919

[Article by I.A. Savenko, M.A. Sarayeva and P.I. Shavrin: "On the Problem of Excess Radiation in Cosmic Rays"]

[Abstract] On the basis of a study of the principal investigations of excess radiation the authors give the most probable composition of this radiation in the equatorial regions at altitudes corresponding to the minimum altitudes of drift trajectories $h_{min} \leq 0$ in the case of registry by a detector on artificial earth satellites with a mass up to 1 ton and heavier artificial earth satellites. The discrepancy in the spectra of solar cosmic rays obtained on the basis of the latitude effect on the "Molniya-1" artificial earth satellite and in exomagnetospheric experiments on "Explorer-41" is attributable to the generation of excess radiation of solar cosmic rays. A comparison of the readings of the neutron channel with the readings of the charged particle channels in instrumentation aboard the "Molniya-1" artificial earth satellite during the proton event of 25 January 1971 does not contradict the assumption of a similarity in the mechanisms of generation of excess radiation of galactic and solar cosmic rays. Figures 1; references 38: 32 Russian, 6 Western.

[136-5303]

ACOUSTOOPTICAL SPECTRUM ANALYZER USED WITH RATAN-600 RADIO TELESCOPE

Moscow PIS'MA V ASTRONOMICHESKIY ZHURNAL in Russian Vol 6 No 1, 1980 pp 61-64

[Article by N.A. Yesepkina, N.F. Ryzhkov, Yu. a. Kotov, V.G. Grachev, A.V. Mikhaylov, S.V. Pruss-Zhukovskiy and A.I. Shishkin, Leningrad Polytechnical Institute, Special Astrophysical Observatory, Nizhniy Arkhyz and Leningrad Affiliate, Special Astrophysical Observatory, Pulkovo: "First Tests of Acoustooptical Spectrum Analyzer on the RATAN-600"]

[Abstract] Tests of an acoustooptical spectrum analyzer (AOSA) were carried out on the RATAN-600 radio telescope in April 1978. A block diagram of the radiospectrometer is shown. The AOSA tests were made jointly with a standard detector at a wavelength of 21 cm. The instrument has the following characteristics: central frequency f_a = 31 MHz, simultaneous analysis band Δf_a = 3 MHz, resolution Δf_{min} = 30 KHz, number of resolvable points M = 100. The optical system includes an LG-78 laser ensuring an output power ~2 mW. The acoustooptical modulator has an aperture 54 mm. Distilled water is the soundconducting medium. The piezoconverter is made of a niobate ceramic. The tests were made by observing the Goldstein region in the neutral hydrogen line at 21 cm. Using the block diagram as a reference, the authors describe individual components and functioning of the instrument. The instrument was found to be effective in practical use. In the future data will be registered on magnetic tape. In addition to observations in the neutral hydrogen line, the lines of hydroxyl (18 cm), formaldehyde (6.2 cm) and water vapor (1.35 cm) will be used. Figures 4; references: 3 Russian, 1 Western.

[223-5303]

III. LIFE SCIENCES

ADAPTATION TO WEIGHTLESSNESS AND ITS PHYSIOLOGICAL MECHANISMS

Moscow IZVESTIYA AKADEMII NAUK SSSR, SERIYA BIOLOGICHESKAYA in Russian No 1, 1980 pp 5-18

[Article by O.G. Gazenko, A.M. Genin, Ye. A. Il'in, L.V. Serova, R.A. Tigranyan and V.S. Oganov: "Adaptation to Weightlessness and Its Physiological Mechanisms (Based on Data From Experiments With Animals on Biosatellites)"]

[Abstract] Four experiments with mammals (white rats of the Wistar line) were carried out on the "Cosmos" biosatellites. The following objectives were set: determining the patterns of adaptation of higher animals to weightlessness conditions; studying the morphobiochemical characteristics of organs and tissues of animals subjected to weightlessness; examining the process of readaptation to terrestrial gravitation after a period of weightlessness. The animals on the "Cosmos-605 and -690" biosatellites were examined 1-2 days after completion of the flight, whereas in the experiments with "Cosmos-782 and -936" the investigations were made as soon as possible after landing time (5-11 hours) in an attempt to distinguish between changes arising in flight from changes which developed after return to earth. The results of these investigations indicate that quite prolonged weightlessness does not cause pathological changes in the internal organs. There were metabolic changes in the hormonal status of the organism making it possible to rate the 18-22 day spaceflight as a moderate stress effect. Changes in the skeletal and motor system were expressed in an atrophy of individual groups of muscles, adaptive transformation of the contractile properties of some of them, osteoporosis and a decrease in bone tissue strength. In addition, there was a decrease in ATPase activity of miocardial myosin and changes in the erythrocytic system: a decrease in erythroidal blood formation and an increase in the level of spontaneous hemolysis of erythrocytes. There were no pathological structural changes in any of the investigated organs. The observed changes in the hypothalamic-hypophyseal-suprarenal system, muscles, bone tissue, the myocardium and other organs were reversely complete normalization of the studied indices. Figures 3, tables 1; references 59: 52 Russian, 7 Western.

[205-5303]

ANTIORTHOSTATIC EFFECT AND THE HUMAN OPERATOR

Moscow FIZIOLOGIYA CHELOVEKA in Russian No 6, 1979 pp 1052-1059

[Article by Sh. T. Avetikyan and A.M. Zingerman, Institute of Experimental Medicine, USSR Academy of Medical Sciences: "The Impact of the Antiorthostatic Effect on the Human Operator (According to Rheographic Data)"]

[Abstract] Considering that the antiorthostatic effect can be used to simulate certain effects of weightlessness, human physiological reactions in antiorthostasis were investigated in relation to the efficiency of the human organism. The experiments were performed on two groups of subjects, one subjected to training in antiorthostasis (6 subjects), and the other untrained. All experiments consisted of three stages: 1) in horizontal position of the body (20 min); 2) in the presence of the antiorthostatic effect, with downward inclination of the head at the angle of 45° to the horizontal (20 min); 3) return to original horizontal position (20 min). The measurements included rheographic recording of the (rheoencephalograms) and of the middle third of the shin. It was found that the antiorthostatic effect associated with stage 2 (-45°, 20 min), which results in hyperemia of the upper half of the body, enhances the tonus of the cerebral arteries and reduces the tonus of the arteries, which contributes to an active pulse redistribution of the blood in the direction of the extremities. Given a sufficient venous efflux from the cranial cavity, the subjects do not show distinct compensatory responses of the cardiovascular system, whereas insufficient venous efflux is accompanied by a higher tonus of cerebral arteries and a higher arterial pressure. It is shown that subjects with distinct symptoms of insufficient efflux of venous blood display a deteriorated operator activity. Figures 2; references 17: 14 Russian, 3 Western.

[184-1386]

ANTIBODIES TO MYOFIBRIL ANTIGENS IN COSMONAUTS AFTER SPACEFLIGHT

Moscow ZHURNAL MIKROBIOLOGII, EPIDEMIOLOGII I IMMUNOBIOLOGII in Russian No 12, 1979 pp 36-39

[Article by R. Yu. Tashpulatov, T.A. Danilova, A.T. Lesnyak, V.I. Legen'kov, V.S. Znamenskiy and Ye. Yu. Dedyuyeva, Institute of Epidemiology and Microbiology: "Antibodies to Myofibril Antigens in Cosmonauts After Spaceflight"]

[Abstract] The sera of cosmonauts were used in studying antibodies to antigens of striated muscle tissue. A study was made of sections of the human and bovine myocardium, which have a similar skeletal musculature, morphological and antigen structure. The study involved 41 sera taken from 15 cosmonauts who had made space flights of different duration and a different number of times; 13 sera were obtained before the spaceflight and 28 after its completion. For nine cosmonauts the investigations were made on a continuing basis for 1-5 weeks after the spaceflight. The presence of antibodies in the sera of cosmonauts was determined by the indirect immunofluorescence method with unfixed sections of human cardiac tissue (group 0) and bovine cardiac tissue prepared in a cryostat. At the same time, during the post-flight period there were anthropometric measurements of muscle mass and body weight of the cosmonauts. The measurements were compared with preflight data. During flight the cosmonauts lost 1 percent to 9 percent of body mass and the parameters of muscles of the lower extremities decreased depending on flight duration and physical load. These parameters returned to initial levels in 5 to 30 days. The sera of the cosmonauts reacted with different structures of the myocardium: sarcolemma, sarcoplasm and platelets; in the sections of bovine cardiac tissue there was also a reaction with cells of the interstitial connective tissue. After flight antibodies to cardiac tissues were discovered in almost 50 percent of the investigated sera. These antibodies were evidently autoantibodies since they reacted to antigens of normal cardiac tissue (group 0). These findings indicate a need for carrying out further investigations for detecting both the role of breakdown of musculature atrophying under hypodynamia conditions and the influence of antigens of human microflora and stress situations with simulation of autoimmune reactions in the body. Figures 1; references 10: 7 Russian, 3 Western.

[175-5303]

NEW EVALUATION OF POSSIBILITY OF LIFE ON MARS

Moscow MIKROBIOLOGIYA in Russian Vol 48 No 6, 1979 pp 1075-1081

[Article by A.A. Imshenetskiy and B.G. Murzakov, Institute of Microbiology: "Search for Life on Mars"]

[Abstract] The article points out that the results of biological investigations of Mars carried out by the Viking probes did not make it possible to obtain definitive information on the presence or absence of life. Therefore, the authors describe experiments carried out with other possible components and analogues of Martian ground. Minerals obtained from the Mineralogical Museum of the USSR Academy of Sciences were used in the investigations. The gas chromatography method was employed in studying the catalytic capacity of minerals possibly entering into the composition of Martian ground; analogues of Martian ground were also used. The laboratory methods are described; and two models of Martian ground are proposed and discussed. A table gives the mineralogical composition of different variants of Martian ground created in different laboratories. It seems clear that the most probable reason for the release of the O_2 observed in experiments under the Viking program is chemical reactions of the decomposition of H_2O_2 under the influence of the mineral components of Martian ground. The data obtained in the reported experiments and their comparison with the results of experiments carried out by the Viking stations indicate that Martian ground is a complex system capable of reactions. This system exerts a catalytic effect on the chemical processes transpiring upon contact with the nutrient medium. There is no basis at present for denying the possibility of life on Mars. However, proper methodological principles must be used in developing a strategy for seeking extraterrestrial life. These principles include the definition of life as a special form of the movement of matter characterized by the capacity to grow, multiply, metabolize, carry out the processes of assimilation and dissimilation of nutrient substrates. The methods which are being developed in the USSR are based on the inoculation of a filtrate of Martian ground into a rich fluid nutrient medium and the dynamic registry of the transpiring processes. Among the methods suitable for the detection of Martian life are nephelometry and turbidimetry, determination of ferroporphyrin proteins, ATP, dynamics of release of $^{14}CO_2$ by the radiometric method with the utilization of tagged nutrient substrates, polarimetry for the detection of change in the optical activity of the nutrient medium. It is concluded that H_2O_2 cannot limit the presence of microorganisms in the Martian ground because mechanisms exist which enable microorganisms to survive when H_2O_2 is present in the medium. Moreover, under Martian conditions the hypothetical microflora could have developed through evolution even more perfect detoxication mechanisms and possibly utilization mechanisms. The important conclusion must be drawn that the use of biogeochemical methods in the search for Martian life was in error. Instead, microbiological methods must be employed for the detection of extraterrestrial life. Figures 6, tables 1; references 19: 11 Russian, 8 Western.

[157-5303]

IV. SPACE APPLICATIONS

'COSMOS-1076' OCEAN SENSING EQUIPMENT DESCRIBED

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 12, Dec 79 pp 40-41

[Excerpts from article by B. Nelepo, academician, Ukrainian SSR Academy of Sciences and director, Institute of Marine Hydrophysics, and Yu. Terekhin, candidate of technical sciences: "A Satellite Over the Ocean"]

[Excerpt] Thus, most of the basic and applied problems of the physics of the ocean boil down to predicting natural conditions in the atmosphere and the ocean, and the way to solve them is by large-scale (for an ocean, on the scale of the entire ocean), regular, operational observations of the processes taking place, with a periodicity of information updating that is no shorter than the time scales of synoptic variability (10-12 days). No amount of research ships and buoy stations can provide this capability.

It is obvious that the solution of these problems is possible only with the help of equipment for remote sounding of the ocean that is installed in spacecraft, which means that the technology, methods and equipment for space oceanography must be developed.

There are a large number of theoretical models that make it possible to describe the processes that are taking place. The input parameters of these models are water and air temperature, the flow of radiant energy, wave parameters and the wind speed in the air layer just above the water, humidity and atmospheric pressure, degree of cloudiness, water color, depth of occurrence and intensity of the discontinuity layer, ice characteristics and so on. Of all these parameters, the temperature of the ocean's surface is the most informative.

At the present time we have accumulated a satisfactory amount of experimental material on remote sounding of the earth's surface (including the ocean) with Soviet satellites of the "Cosmos" and "Meteor" series, in addition to American meteorological satellites, which use separate systems for the visible, infrared and microwave bands. These data demonstrated the great potential capabilities of space technology for investigating the ocean and the importance of creating a specialized oceanographic earth satellite equipped with a complex of research equipment that makes it possible to obtain information about the physical parameters of the ocean and the atmosphere.

"Cosmos-1076", which was launched on 12 February 1979, was the first satellite from our country with the mission of working out techniques for the solution of these problems.

One of the sources of information about the world ocean is measurement in the visible band of the spectrum (wave lengths from 0.4 to 0.7 micrometers), in which the spectral composition of the ascending light flux carries the most information. It contains information about the biological productivity of the waters and their optical characteristics, which makes it possible to distinguish different water masses, determine their boundaries, and detect vortices, water uplift zones and other dynamic formations. In coastal regions, continental drainage waters are distinguished quite well according to their color, distribution and interaction with the waters of the open sea.

Investigations of the ocean in this band differ from measurements made over the continents. The variety of colors, shades and contrasts on land is incomparably greater than on the ocean's surface. In most places, the different natural land formations have quite clear and sharp boundaries. In the waters of the ocean these features are much less clearly expressed, and even the geographical correlation of the results of observations is done by a more complicated method. This is why the requirements for the equipment's local resolving power in oceanographic research are not so stringent (except for observations of ice fields and sea-land boundary regions) as they are for land observations.

On the other hand, the equipment's sensitivity for detecting differences in water must be much greater. The requirements for spectral resolution are also higher. Therefore, the visible-band equipment installed in the "Cosmos-1076" oceanographic satellite has pass bands that do not exceed several nanometers in width. Equipment with such high spectral resolution has been installed in a satellite for the first time.

Unfortunately, visible-band equipment has a substantial flaw: the impossibility of making measurements under conditions of solid cloud cover and on the night side of the earth. Therefore, in order to obtain the characteristics determining the state of the atmosphere and the underlying surface at any time of day, equipment operating in the infrared and microwave bands is used. In the infrared band a significant part of the underlying surface's characteristic radiation is absorbed by the atmosphere. However, there are several "transparency windows" in which the radiation in this band does not undergo substantial distortion. One of them lies in the so-called far infrared band, with wave lengths of 8-12 micrometers. It is used to determine the temperature of the underlying surface.

Since the temperature contrasts on the continents are usually quite substantial because of great differences in the thermal conductivity of objects for measurements there it is possible to use equipment with low spectral selectivity. For instance, the "Meteor" satellites contain infrared equipment operating in the 8-12 micrometer band, in which a large part of the thermal energy going out from the earth into space is concentrated. At an altitude of 600-700 km it has a field of view about 1100 km wide, its local resolution is approximately 15 km and its temperature determination accuracy is 2-3°C.

For measurements in the ocean, however, such accuracy is unsatisfactory. Even in intensive vortices, as a rule the temperature contrast relative to the surrounding waters does not exceed 2-3°C. The contrasts in upwelling zones, where colder and more mineralized water rises, are not much greater. Therefore, a suitable accuracy for measurements of the ocean surface's temperature must be a value that is in no way worse than 0.5°C. The situation is complicated by the fact that remote measurements determine not the temperature of the agitated upper layer of the ocean, which is required for the solution of oceanographic problems, but of the so-called "surface skin film" that is several millimeters thick, in which the temperature gradients reach tens of degrees per cm. The physical characteristics of this film depend heavily on the overall hydrometeorological situation at the moment of the observation. Another factor that has a great effect on the accuracy of the determination of the water's temperature is the correctness of the allowance for radiation attenuation in the atmosphere; that is, the atmosphere's transfer function.

Thus, increasing the accuracy of measurements of the ocean surface's temperature--the most important hydrophysical parameter--is possible if a complex of problems of a theoretical, methodological and technical nature are solved. They include the development and creation of a hydrothermodynamic model of the ocean's surface layer together with the skin layer, the development of improved techniques for determining the atmosphere's transfer function, improving the spectral sensitivity of the equipment, and increasing the number of measuring channels within the limits of the atmosphere's "transparency window." The launching of "Cosmos-1076" made it possible to begin to solve these problems.

In a complex with the infrared radiometer in the satellite, there is five-channel microwave radiometer that operates in the centimeter band. The information from this instrument is used both to increase the accuracy of the determination of the underlying surface's temperature and the atmosphere's parameters and to evaluate the state of the water's surface (the degree of wave action and storm zones, in particular), ice characteristics, the moisture content of clouds, and precipitation zones.

The specialists have high hopes for the possibility of using equipment for active radar sounding of the ocean's surface that will make it possible to obtain two-dimensional wave action spectra and evaluate the wind speed and direction and wave height--characteristics detemining the interaction in the ocean-atmosphere system--as well as the processes taking place in the ocean's active layer.

In order to collect, store and transmit data to ground information receiving points, the satellite is equipped with an on-board information system. The orientation and stabilization system insures that its angular position in space is correct. It is also equipped with a correcting engine unit and a system for independent orientation of the solar batteries.

The satellite's scientific equipment complex is controlled by a special unit that also assigns the working modes for the measuring equipment and the system for collecting and transmitting the information from buoys and ships. The latter constitute a system of reference points and make direct measurements in the ocean for the purpose of monitoring and calibrating the satellite's equipment.

The equipment on the satellite regularly collects information accumulated by automatic buoy stations and transmits it to reception centers for processing. In addition to solving the methodological problems and those involved in calibrating the remote-sounding sensors that are part of the satellite's equipment, the use of a system of automatic buoy stations in the ocean that determines hydrophysical characteristics with respect to depth makes it possible to formulate the question about the transformation of surface fields (measured by the satellite) into the ocean's depths, at least within the limits of the active layer.

The launch of the "Cosmos-1076" spacecraft marks a new stage in the study of the ocean. We hope that working with it will enable oceanographers to achieve substantial advances in understanding the processes taking place in the ocean-atmosphere system.

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[120-11746]

USE OF TRANSLOCATION METHOD IN MARINE GEODESY

Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 11, 1979 pp 8-12

[Article by Yu. S. Mikhaylin: "Possibility of Use of the Translocation Method in Marine Geodesy"]

[Abstract] Satellite method are promising in work in remote ocean areas. This article examines the possibility of using one such method, the Doppler integral satellite method. Experience in operating the "Transit" satellite Doppler system has shown that it makes it possible to determine the absolute coordinates of ships in a unified geocentric coordinate system at any point on the earth's surface from observations from one pass of a navigational AES with errors as little as 20-40 m. The principal sources of errors are errors in data on geocentric coordinates of the navigational AES and the ship's speed. This method for using Doppler observations of AES for determining relative coordinates is known as the translocation method. Included in its most precise variant are only those segments of orbital arcs for the observed AES passes which are taken in by synchronous observations from reference stations and the station to be determined. As a result the differences in station coordinates can be determined considerably more precisely than the

geocentric coordinates of each station separately. The translocation method has already been used successfully in work on the land. As indicated in this paper, the experience of work on land can be used in evaluating the influence of errors in ephemeris in determining relative positions by the translocation method at sea. The author demonstrates the possibilities for increasing the accuracy in determining coordinates in shelf zones at considerable distances from the shore by using simultaneous Doppler satellite observations from a ship and from an on-shore control point, as well as additional information on the ship's speed and course. Proposals are made for organizing the work and experimental investigations for solving a number of problems in marine geodesy. References 6: 4 Russian, 2 Western.

[149-5303]

MAPPING OF EARTH FROM SATELLITE USING RADIO EMISSION AT 0.8 CM

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 15 No 12, 1979 pp 1262-1270

[Article by S.T. Yegorov, V.A. Plyushchev, A.A. Vlasov, V.F. Morozov: "Mapping of the Earth From Artificial Earth Satellites on the Basis of its Natural Radio Emission at 0.8 cm"]

[Abstract] In 1976, during experimental launching of "Meteor" satellites, specialists checked scanning radiometric apparatus operating at a wavelength 0.8 cm and obtained radiothermal maps of different regions of the earth. The radiothermal image covers a sector of the earth's surface from the Taymyr to 40-50° north latitude in the Pacific Ocean. The sectors of ocean areas not covered by ice appeared in dark red, red and brown colors, land--in olive, green and blue, ice cover--yellow to blue. This specific case, represented by figure 1 in the text, reveals a better visibility on the radio-thermal image as compared to the IR image of the underlying surfaces (land, water, ice). A comparison of IR, radiothermal and synoptic data indicates that IR apparatus registers cloud cover of any type, including weak, upper-level cirrus clouds. Microwave apparatus registers cloud cover with increased moisture content, but cirrus clouds are virtually transparent for radio-emission in the microwave range. Another example in this article (figure 3) compares and contrasts ice conditions constructed using data from aircraft ice reconnaissance and a corresponding sector of the radiothermal image. There is a completely satisfactory quantitative coincidence of data on ice continuity on the map of ice conditions and data obtained from an analysis of radiometric measurements. In still another example (figure 5) there was a comparison of a radiothermal image and a map of ice conditions in the Kara Sea. This comparison shows that the boundaried between the ice cover and the open water on the radiothermal image correlate quite well with these same boundaries on the ice conditions map. These comparisons of data on ice conditions indicate that on the basis of an analysis of radiothermal images obtained from artificial earth satellites it is possible to carry out routine planning of a large-scale strategy for the convoying of ships along the Northern Sea Route. Figures 6, tables 2; references 5: 1 Russian, 4 Western.
[150-5303]

MEASUREMENT OF OUTGOING RADIATION IN CO_2 ABSORPTION BANDS

Moscow IZVESTIYA AKADEMII NAUK SSSR, FIZIKA ATMOSFERY I OKEANA in Russian Vol 15 No 12, 1979 pp 1253-1261

[Article by V.P. Kozlov and Yu. M. Timofeyev, Leningrad State University: "Optimum Conditions for Measurements of Outgoing Radiation in CO_2 Absorption Bands and Accuracy of the Method for Thermal Sounding of the Atmosphere"]

[Abstract] This paper is devoted to an analysis of the possibilities of increasing the accuracy of the method of thermal sounding of the atmosphere on the basis of improvement in satellite measurement systems. It gives the results of computations of the optimum conditions for measuring outgoing thermal radiation in the CO_2 absorption bands at 15 and 4.3 when using these bands separately and together. A precise quantitative formulation of the problem of optimization of conditions for measuring the radiation spectrum was given earlier (V.P. Kozlov, TEORIYA VEROYATNOSTEY I YEYE PRIMENENIYE, 19, No 1, 226-230, 1974). Later (V.P. Kozlov, et al., IZV. AN SSSR, FAO, 12, No 5, 494-505, 1976) this formulation was applied to optimization of measurement conditions in the problem of indirect reconstruction of the humidity profile. These earlier studies were used as a point of departure in an analysis of the spectral properties of atmospheric absorption in the two mentioned ranges. It was possible to select 28 spectral intervals in the band 15μm and 30 in the band 4.3μm, these describing in considerable detail the optical properties of the atmosphere. The following assumptions are made: 1) the atmosphere is cloudless, 2) in the measurements only the random component of errors is present, 3) the radiation model of the atmosphere is known precisely. The article discusses the information yield from measurements of outgoing radiation and the optimum spectral channels and evaluation of sounding accuracy. It was found that the method led to an increase in accuracy in determining vertical temperature profiles in comparison with traditional satellite instruments. It is concluded that the measurements in bands centered at 4.3 and 15μm contain an appreciable amount of independent information on the vertical thermal structure of the atmosphere. Figures 2, tables 3; references 14: 12 Russian, 2 Western.

[150-5303]

SPACE METHODS IN SEEKING DEPOSITS OF THERMOMINERAL WATER

Yerevan IZVESTIYA AKADEMII NAUK ARMYANSKOY SSR, NAUKI O ZEMLE in Russian Vol 32 No 5, 1979 pp 53-57

[Article by R.B. Yadoyan, Institute of Geological Sciences, Armenian Academy of Sciences: "Special Research Methods in Search for Deposits of Thermomineral Waters"]

[Abstracts] Space photography and television surveys, microwave and radar surveys make it possible to cover large territories and obtain diverse information on the subsurface hydrosphere. Space methods make possible a direct or indirect study of ground water, its areal distribution, inflow and discharge. A space survey is effective in studying the interrelationship between surface and ground water. It makes it possible to ascertain the centers of discharge of ground water in rivers, lakes and seas, to define sectors of propagation of contaminants and trace (in time) the limits of fresh, saline and contaminated waters, to discover hydrotherms, taliks and ice encrustations, to map regions of their development, to determine more precisely the geological-tectonic structure of the territory and the distribution of water-bearing and water-impermeable rocks of various composition, to detect the presence, depth and approximate mineralization of ground water in arid regions, and to estimate the moisture content of soil. One such study conducted in the USSR, described here, was the interpretation of space surveys of the Greater Caucasus region, carried out in order to clarify the regional patterns of distribution of thermomineral waters. Recently space photographs were used in solving hydrogeological problems in Armenia. In the latter case the photographs used were from the "Soyuz-12" spaceship and medium-scale panchromatic aerial photographs. It was possible to carry out hydrogeological regionalization on this basis. This work has demonstrated that aerospace surveys are necessary and effective for the planning of detailed search for mineral waters in folded mountainous regions. An infrared survey is another research method effective in such work; this has been successfully employed in a number of Western countries. References 10: 4 Russian, 6 Western.

[195-5303]

SPACE SURVEYS REVEAL ANTHROPOGENIC CHANGES IN ENVIRONMENT

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 5, GEOGRAFIYA in Russian No 1, 1980 pp 18-24

[Article by V.P. Burov, Ye. V. Glushko and Yu. G. Yermakov, Department of Physical Geography of Foreign Countries, Moscow University: "Study of Anthropogenic Changes in Environment From Space Photographs"]

[Abstract] A great quantity of high-quality space photographs of the earth's surface now is available and much experience has been accumulated in interpreting them. This has made it possible to generalize the results of the investigations and to proceed to the formulation of a uniform classification of anthropogenic formations, making it possible to study them using space methods. The basis for the classification is a breakdown of anthropogenic formations into nine types which stand out sharply on space photographs. These are: field, garden-plantation, meadow-pasture, forest, hydraulic, industrial-mining, industrial-processing, settlement and recreational types. These defined types were broken down further, taking into account methods of economic management and natural-climatic conditions. In accordance with this classification the authors compiled tables of keys of anthropogenic formations making it possible to systematize their interpretation criteria.

The system of keys not only generalizes information on the nature of the image of anthropogenic formations, but also serves as a basis for the extrapolation of interpretation criteria on the photographs of poorly studied and unvisited regions. The keys are plane images obtained under optimum technical and natural survey conditions in the absence of cloud cover. The survey season (mid-summer) favored clear depicting of the anthropogenic formations on the space photographs. At the scale of the investigation the detail of interpretation of the anthropogenic formations is limited by the spatial resolution of the photographs, i.e. 70 m on the ground. Figure 1 in the text shows nine photographs, each one corresponding to one of the nine main types in the classification. As an example of the possibilities of the method, details are given on type I (field type). Figure 2 is a set of photographs, each corresponding to a subtype of type I. In the future the system of keys can be used in a changeover from visual intepretation to automatic recognition of features on the basis of image structure. Figures 2.

[224-5303]

V. SPACE ENGINEERING

KRT-10 SPACE RADIO TELESCOPE DESCRIBED

Moscow NAUKA I ZHIZN' in Russian No 11, 1979 pp 2-6

[Article by Yu. Danilov, doctor of physical and mathematical sciences, Yu. Kuleshov, engineer, and V. Rudakov, candidate of technical sciences: "The First Space Radio Telescope"]

[Text] It seems that not so long ago Citizen of the Land of the Soviets and Communist Yuriy Alekseyevich Gagarin made the first step into space and completed his 90-minute orbital flight, his first historical loop around the planet. And now already many dozens of people have travelled the path laid by our first cosmonaut. First for hours, then for several days, weeks and months man has been in space, rendered habitable by him. These days a new unit of time for space flights has come into use--the 12th expedition in a "Salyut" series station has been completed, and its participants, USSR pilot-cosmonauts and heroes of the Soviet Union Vladimir Lyakhov and Valeriy Ryumin have worked in near-earth orbit for a year and a half. And work they did: for a long time now a spaceflight has become a job not only for heroes, but for great workers. As did the previous crews of the "Salyuts," V. Ryumin and V. Lyakhov did an immense amount of research work in studying earth itself, its climate and natural resources, and in studying biological and physical processes under spaceflight conditions, relating to new technological processes and to the development of space technology itself.

During the 12th expedition a completely new trend was revealed--research by means of an orbital radio telescope. Specialists who took part in its creation tell about this interesting tool.

Associated with the flight of the "Salyut-6" orbital station is such an important success of Soviet space technology and radio electronics as the launching and unfolding in near-earth orbit of the KRT-10 radio telescope. Its very name stands for "space radio telescope with a 10-meter antenna." The unfolding of the KRT-10 space radio telescope is not only the first step in radio astronomy outside the atmosphere. It is also the beginning of a fundamentally new trend in work in space--the creation of sectional and folding structures, in particular, of such equipment as large antennas for various purposes.

The space telescope was delivered to the "Salyut-6" orbital station by the "Progress-7" transport ship in the form of individual units. Let us list the key units of the KRT-10 radio telescope system. First there is the opening "umbrella"--a parabolic reflector antenna which directs the received radiation to a so-called focal container fastened to an extendable tripod. The focal container is a sealed unit with a heat regulation system, on the outside of which are placed exciters which receive the energy collected by the reflector. Inside the container are five high-sensitivity radio receiver radiometers in which the received signals are amplified and detected and are then transmitted further to those sections and units of the system which are well inside the station. Included among these consecutive units is equipment for converting received signals into a form required for recording--for recording them and transmitting them to earth.

The station's crew--pilot-cosmonauts V.A. Lyakhov and V.V. Ryumin--moved the radio telescope's units inside the station and mounted part of them in the working section. The so-called antenna extension equipment was mounted at the station's docking unit. The antenna itself was fastened to it in the folded position (figure 1). The individual units of the KRT-10 system were interconnected by cables and connected to the on-board electric power network and the telemetry system. The KRT-10 system was controlled from a console, on the panel of which were located buttons for starting and selector switching as well as illuminated and pointer-type indicators of equipment modes and states. All work relating to assembly was carried out under normal conditions inside the "Salyut-6"--"Soyuz-34"--"Progress-7" space complex, more precisely in the transfer chamber of the "Salut-6" station.

After the crew had completed assembly and mounting of the entire KRT-10 complex, trial tests were made of the extension system and then the cosmonauts moved into the working section and closed the airtight hatch between this section and the transfer compartment. The time began for one of the most important operations--undocking of the "Progress-7" spaceship and extension and opening of the KRT-10 antenna.

The process of the antenna's opening could be observed by means of a television camera set up in the "Progress-7" transport ship as it was undocked. The television image from "Progress-7" was transmitted to earth, and everyone at the control center who saw this telecast undoubtedly experienced natural impatience and emotion. Now the "Progress-7" undocks and the "Salyut-6" station can be seen well on the screen. Lingering slightly, earth gives the command to extend the antenna. The crew reports that the illuminated indicators show that extension is proceeding normally. The antenna is completely extended. Finally the command comes to open the antenna and on the screen around the station appear a halo--the grid of the open KRT-10 antenna is gleaming in the rays of the sun.

Work with the first operating KRT-10 space radio telescope began on 18 July, immediately after departure of the "Progress-7" transport ship. First the antenna was aligned and its directivity diagram was plotted, and then began a cycle of astrophysical and geophysical investigations.

A few words about alignment. A radio telescope--an instrument for observing remote objects--has a narrow field of view, i.e., a small angle between the limits of the visible section. For a radio telescope of such a class as the KRT-10, the angle of view is not greater than a few degrees. In order to aim a radio telescope precisely, it is necessary to know the positions of its so-called electrical axis--the line coinciding with the direction of the best reception of signals. In a radio telescope the "field of view" is estimated from the antenna's directivity diagram. Usually as the width of this diagram is considered the solid angle at whose boundaries the power of the received signal drops twofold relative to the maximum. The larger the antenna and the shorter the received wave, the more narrow the angle of view of the telescope and the narrower the directivity diagram.

Photo 1 Caption: The frame of the antenna of a space radio telescope designed for conditions of weightlessness in ground tests is placed on a special stand with counterweights which compensate earth's gravity. A group of specialists inspects one of the variants of the frame of a folding antenna which is hung on a test stand.

Before the start of observations with the KRT-10 it was necessary to determine the position of the antenna's axis in relation to the geometrical axes of the station and to measure the width of the directivity diagram. These measurements were made by aiming the antenna at a well-known source of radio emission, Cassiopeia A in the constellation Cassiopeia. Then the antenna was shifted by a small angle and, simply speaking, was slanted, measuring simultaneously both the angle of this shift and the signal level. Since the antenna is connected rigidly to the station, aiming was accomplished by rotating the entire station. A so-called star tracker--an instrument in whose field of view are visible specially selected reference stars--was used to aim the antenna and to monitor its position.

Astrophysical investigations included observations of pulsar PSR0329+054 and scanning of a section of the Milky Way. A pulsar with relatively powerful emission was selected for observation. The radio pulse repetition rate in this pulsar is approximately 0.7 s and the length of the pulse is about 0.01 s.

A pulsar's pulses travelling along a path to earth through the interstellar and interplanetary medium are altered to a certain extent. The shape of the pulse is distorted; in particular, scintillation originates--an alteration in the observed amplitude of the signal. The investigation of scintillation provides information on the interstellar medium, and simultaneous observations of scintillation from spaced points makes it possible also to form an opinion about the emitting object. This is why during investigations of the pulsar the KRT-10 was operating simultaneously with a large radio telescope with an antenna 70 m in diameter, recently constructed in the Crimea. The processing of signals received at spaced points requires the precise time correlation of recordings. For this purpose, on board the station a precision timing unit was employed.

The resolution of a two-antenna system depends on the distance between antennas. By means of the KRT-10 and the ground antenna of the radio telescope in the Crimea an antenna system whose dimensions exceed the diameter of earth was realized for the first time. The sensitivity of such a system depends on the product of the collecting surfaces of the antennas, and here the relatively small KRT-10 antenna was assisted by the large ground antenna.

Taking a radio telescope beyond the limits of earth made it possible to begin detailed investigation of radio emission from different sections of our planet. This is a question not of artificial radio emission, nor of signals from a radio station, but of emission originating as the result of certain natural spontaneous processes on dry land and in the oceans. Coming under this heading first of all is the normal radio emission of a heated body. Detailed investigations of earth from satellites have been conducted for many years now, but a large antenna with a relatively narrow directivity diagram makes it possible to study in detail the radio emission of certain small areas of the surface. For example, an antenna with a directivity diagram width of 2° (and this is a totally realistic value for an antenna of the KRT-10 type) from an altitude of 400 km can "see" a section of the earth's surface measuring 8 km.

Investigation of the earth's radiothermal emission provides extensive information for geologists, physical oceanographers, soil scientists and meteorologists. As a result of these investigations it is possible to obtain data on the moisture content of soil, snow cover, and the salinity of the sea, which will be utilized in different branches of the national economy and the earth sciences. Here it must be stressed that optical facilities for observing earth from space still provide considerably better spatial resolution than does a space radio telescope. But it must be remembered that at any point in time 70 to 80 percent of the earth's surface is covered by clouds, and at night optical observations of earth's surface are impossible. Under these circumstances a space radio telescope which receives radiation from earth round the clock and in any weather can be called an "all-seeing eye."

The creation of the KRT-10 radio telescope, space radio astronomy's firstling, required serious preliminary investigations and experimental studies, discussions of different projects, calculations, mockups, experimental models and tuning and testing equipment. A procedure was developed for making experiments according to which V.A. Lyakhov and V.V. Ryumin were trained on earth.

A space radio telescope is an instrument which has a great future. On earth gravity and wind loads create serious obstacles in the way of enlarging antennas (cf. the article "Beyond the World's Horizon," NAUKA I ZHIZN', No 6, 1978). They are cumbersome and weigh many tons. In addition the atmosphere and ionosphere restrict the band of waves which can be received, and interference of natural and manmade origin hampers observation even in the narrow radio channels specially assigned for radio astronomy. As far as multi-antenna systems are concerned, the maximum possible distance between antennas for earth has already been reached--the diameter of the earth. A space radio telescope does not have these limitations.

The conditions of weightlessness have made it possible to construct a 10-meter antenna with a total weight of 200 kg; a similar ground antenna would have weighed many times more. Weightlessness will become a decisive advantage when sectional antennas with a diameter of hundreds of meters, and then of several km are created in space. Finally, in space it is possible in principle to space radio telescopes as far apart as one desires. In addition, the orbiting motion of a KRT makes possible smooth alteration of the base line--the distance between antennas--in terms of magnitude and direction. And this makes it relatively simple to employ methods of synthesizing images of sources (on earth for this purpose antennas are moved on rails, for example).

A space radio telescope has its problems, of course. First of all there is the insertion and assembly of large KRT's in orbit, as well as aiming them at the target of observation and keeping them in this position--stabilization. It is necessary somehow to wrestle with possible deformation of the antenna under the effect of solar radiation by using, for example, materials with a low coefficient of thermal expansion. Finally, many problems are involved in ensuring the long-term operation of a KRT and in maintaining it.

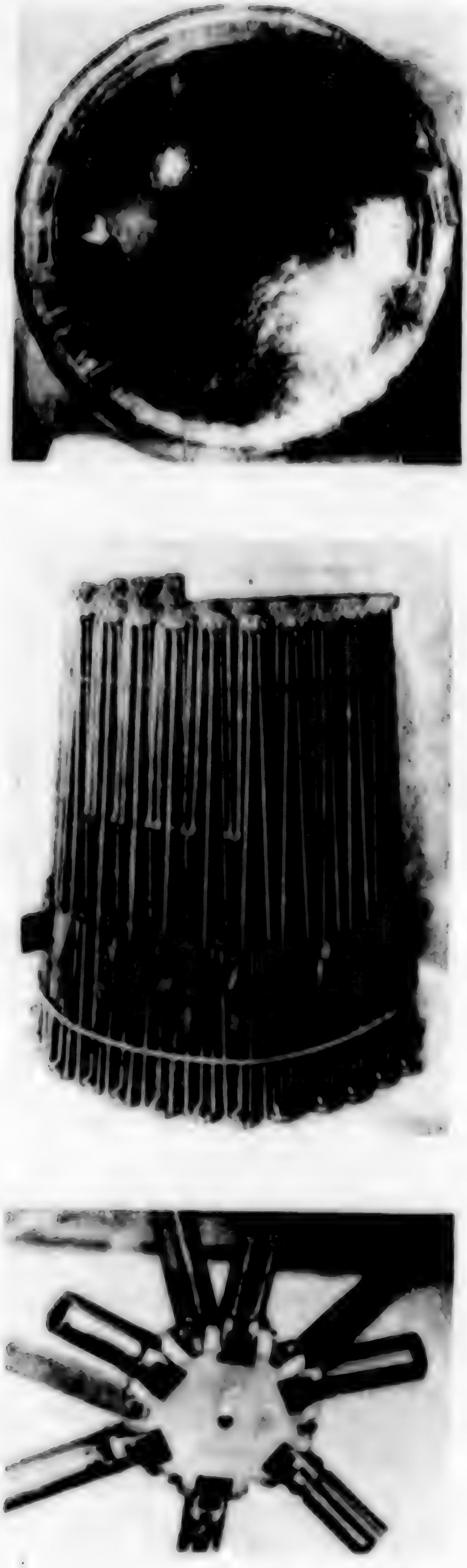


Photo 2 Caption:
In the process of creating the KRT-10 radio telescope, scientists and designers considered many variants of antennas for it and developed and investigated a number of experimental models of the antenna itself and of its individual units. The photographs show the variant of an antenna with an inflated reflector (upper left photo), one of the preliminary models of an antenna in the folded position (middle photo), and a variant of the basic assembly of the folding frame (lower photo).

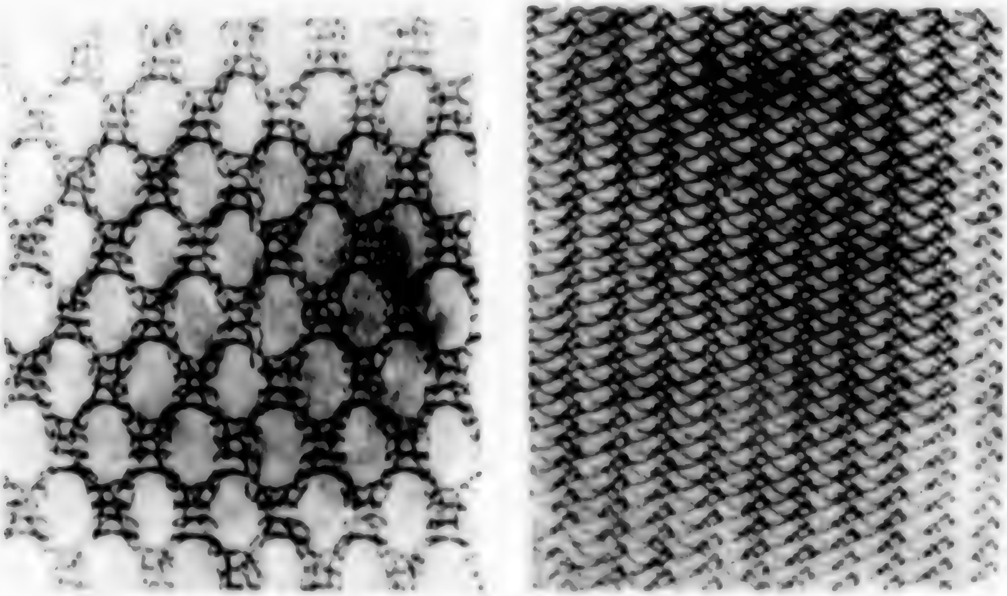
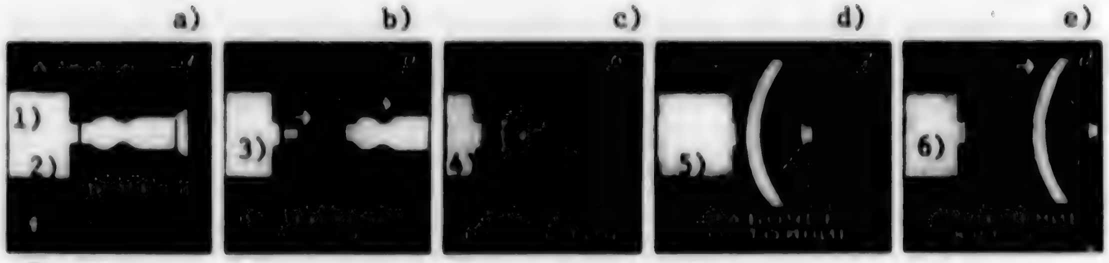


Photo 3 Caption: Models, studied in the process of developing the KRT-10, of the metal grid forming the reflecting surface of the antenna. A cell measures approximately 3 mm.

An important contribution to the creation of large sectional structures in space will be made by cosmonauts. The EVA of V.V. Ryumin and V.A. Lyakhov and the work done by them have demonstrated that cosmonauts will play an important role in assembly, in investigations and in repair operations.

The complexities involved in constructing large space antennas do not appear to be insurmountable. Meanwhile the advantages of these antenna systems are attracting the very keen interest not only of radio astronomers, but of communications specialists, geophysicists and power engineers as well. This is a token of the fact that after the first step, after the creation of of the first 10-meter radio telescope in the world, the KRT-10, there will follow further studies aimed at the creation of larger and further improved systems.



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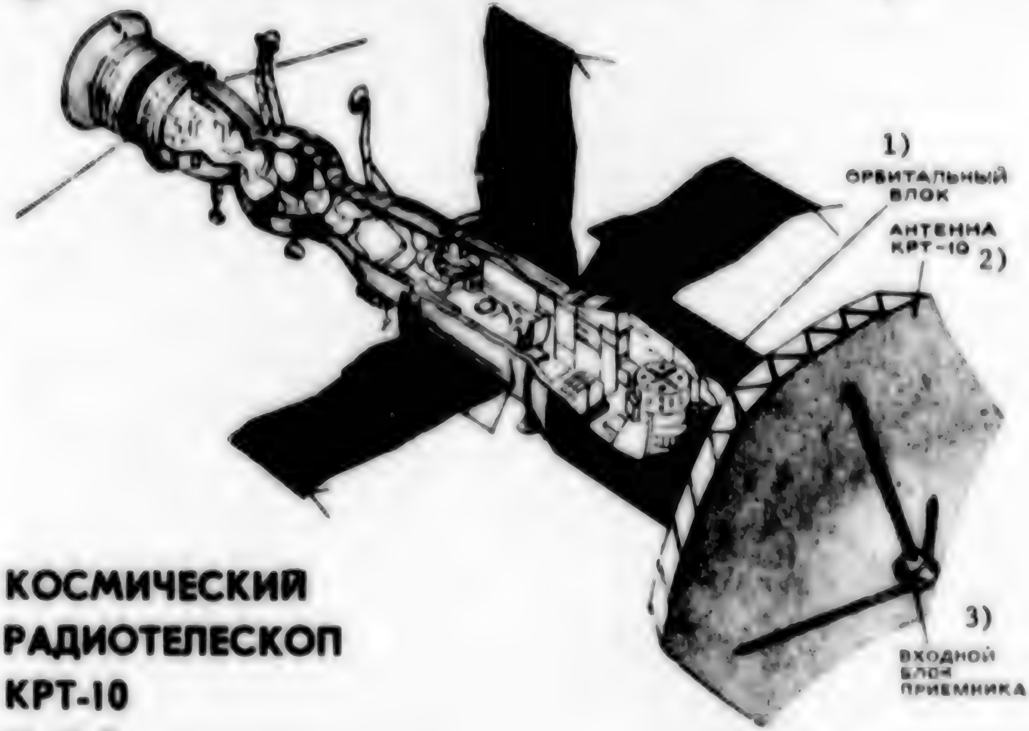
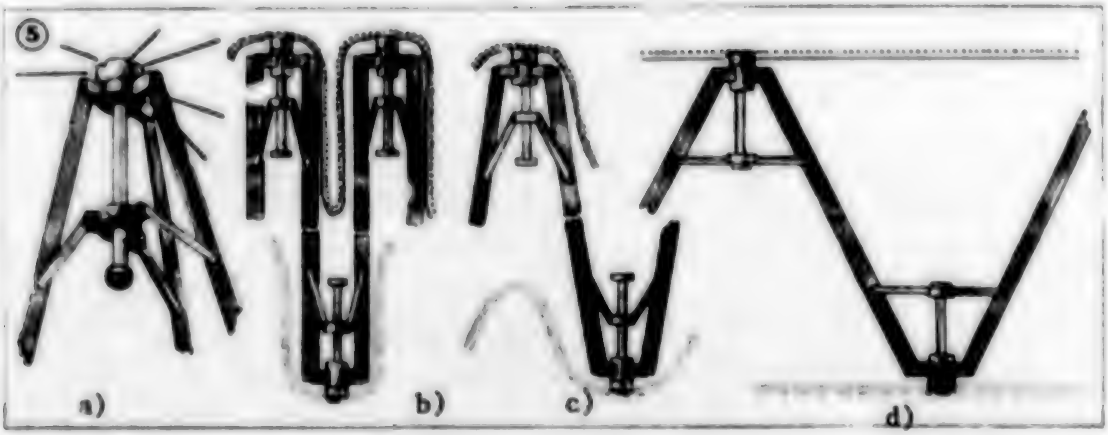
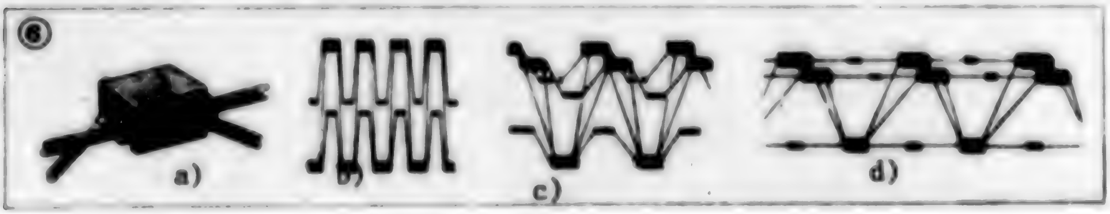


КОСМИЧЕСКИЙ РАДИОТЕЛЕСКОП КРТ-10

(см. стр. 6)





Caption for Figures 1 and 2 on page 33

Key for Figure 1:

1. "Salyut-6"
2. "Progress"
3. Extension of KRT-10
4. Start of opening
5. Working position
6. Detachment of KRT-10

Delivery and Opening of KRT-10

The radio telescope delivered into orbit by the "Progress-7" transport ship (Fig. 1a) was assembled inside the "Salyut-6" station and then, after the transport ship had undocked, the KRT-10 antenna was extended outside in the folded position (b). Opening of the antenna (c,d) took place under the effect of springs located in the main assemblies of its frame (Figs. 4 and 5). Here all springs began to operate practically simultaneously, when the ring which encircled the folded antenna and prevented its opening had been removed. At the end of the studies the antenna was detached from the "Salyut-6" station and thus the equipment bay docking unit was freed (e).

Key for Figure 2: KRT-10 Space Radio Telescope

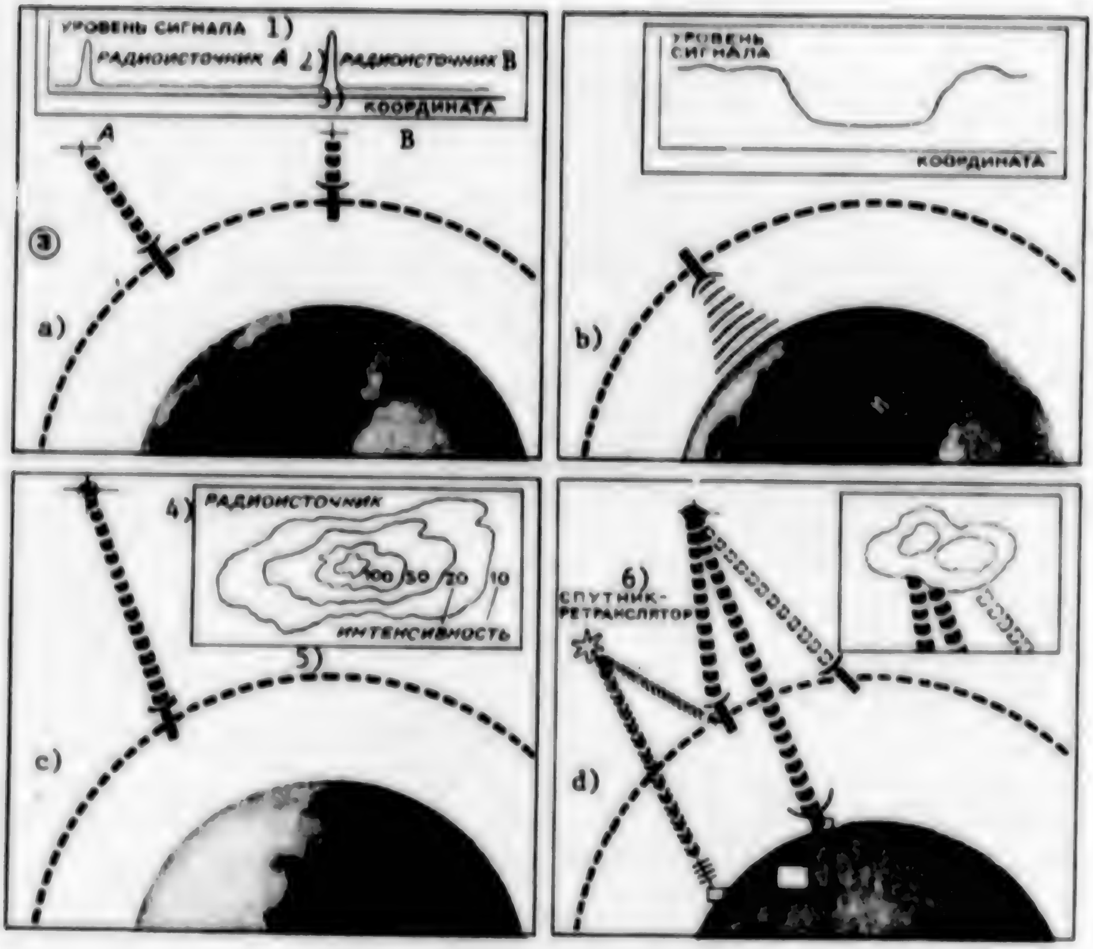
1. Orbital unit
2. KRT-10 antenna
3. Receiver input unit

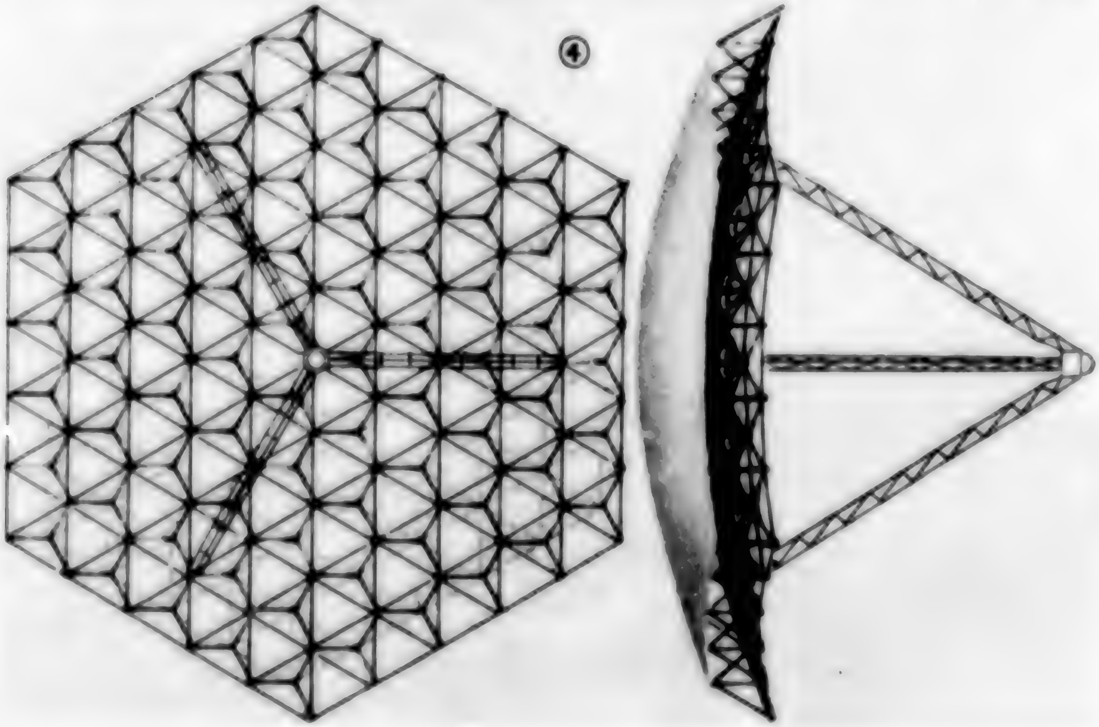
Some Experiments Which Can Be Performed With a Radio Telescope

Moving in orbit, a radio telescope can measure the level of cosmic radio emission and because of the directivity of the antenna record individual radio sources (Fig. 3a). Through slight movements, or tilts, a radio telescope with a pencil beam antenna can investigate the structure of an individual radio source (c). An antenna aimed in the direction of earth makes it possible to record radio emission from various sections of earth's surface (b). A space radio telescope can operate in conjunction with a large ground radio instrument, in particular, in the radiointerferometer mode. Signals from a space radio telescope in this case can be relayed to earth via a communications satellite (d).

Antenna of KRT-10 Radio Telescope

The antenna's reflector is made of a fine metal grid (shown in Fig. 5 by the dotted line) stretched onto a three-dimensional frame. The base of the frame is made of relatively thin metal rods. The length of a rod is about 80 cm. The ends of the rods are hinged to standard basic assemblies of the frame (Fig. 5a)--in each assembly there is a spring which extends the rods, and all springs, thus, open the entire frame (Fig. 5b, c, d). An important element of the structure are the sections of thin cable of





Caption for Figure 3 on page 35

Key for Figure 3:

1. Signal level
2. Radio source A.
3. Coordinate
4. Radio source
5. Intensity
6. Satellite radio relayer

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precisely determined length, which connect each basic assembly with all neighboring assemblies (in Fig. 5 the sections of cable are indicated by [solid] lines). It is precisely these sections of cable which determine the extent to which the rods can be extended under the force of a spring, i.e., in sum determine the shape of the frame. The sections of cable form a large widely-spaced grid on which lies the closely-spaced fine grid of the reflecting surface and an auxiliary so-called technological grid (shown by the [broken] line). It is important to note that in folding the antenna all springs are disconnected, as it were, and they are raised only after the antenna has been folded and constricted by the ring which prevents its opening. Thus, it is possible to fold the antenna without encountering resistance from the springs, and when the ring is removed they all will open the antenna simultaneously. In a similar manner, by means of spring assemblies (Fig. 6a), the three "legs" (Fig 6b, c, d), to which the focal container with the exciters and radio receivers is fastened, are opened and straightened. Flexible cables run from it along the "legs" connecting the antenna to the equipment located inside the "Salyut-6" station itself.

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VI. SPACE POLICY AND ADMINISTRATION

USSR PROPOSES TO LAUNCH THIRD INMARSAT SATELLITE

Paris AIR & COSMOS in French No 796, 19 Jan 80 p 35

[Article by P.L.: "European and Soviet Launchers for INMARSAT Satellites"]

[Editorial Report] An article published in the 19 January 1980 issue of AIR & COSMOS reveals that the Soviet Union has proposed to launch the third in the series of maritime communications satellites to be orbited in the early 1980's under the direction of INMARSAT. The European Space Agency will furnish the three MARECS satellites, and the "Ariane" rocket will be used to launch the first two satellites, MARECS-A and -B, in December 1980 and April 1981. It had been expected that ESA's "Ariane" would also launch MARECS-C until INMARSAT received the Soviet launch proposal. Such a plan would require that the European satellite be adapted to the Soviet booster, a move which would entail additional costs of up to several million francs.

[218-P]

'TASS' ANNOUNCES CREATION OF 'MORSVYAZSPUTNIK'

Moscow TASS in English 1334 GMT 25 Feb 80

[Text] Moscow, 25 February, TASS--A program for a broad use of spacecraft for sea communication and shipping has been outlined in the Soviet Union. With this aim, a system is created providing for the use of artificial earth satellites of the "Cosmos" type.

An all-union MORSVYAZSPUTNIK (sea communication satellite) organization has been set up under the USSR Ministry of the Merchant Marine. It will be charged with processing data received by means of Soviet and international artificial earth satellites necessary for ensuring communication and navigation on the high seas. The satellite system will eliminate breaks of many hours in radio communication between sea-going ships and ports caused by magnetic storms and other radio interference. The "ship--satellite--ground station" radio bridge will speedily and effectively link subscribers.

Already now big Soviet ships under construction are equipped with satellite communication apparatuses, due to which the control of ship traffic will be more effective in the future. The communication system will be used in navigation: satellites may become outer space beacons.

The USSR is a member of the INMARSAT international satellite communication organization, which was set up recently. The convention on its establishment came into force in July last year. The aim of INMARSAT is the control of a system, which is to be created on an international basis for ensuring communication between sea-going vessels and coast by means of space satellites.

[253-F]

SOVIET-INDIAN COOPERATION IN SPACE EXPANDS

Moscow TASS in English 1044 GMT 27 Feb 80

[TASS report: "USSR-India: Cooperation in Space"]

[Text] Moscow, 27 February, TASS--A joint flight of a Soviet and an Indian cosmonaut will become a new step in Soviet-Indian cooperation in space, a TASS correspondent was told by Nikolay Novikov, deputy chairman of the "Intercosmos" council at the USSR Academy of Sciences. He said that the friendly international family of the Yuriy Gagarin Cosmonaut Training Center near Moscow, where representatives of countries participating in joint manned flights are trained, will be glad to welcome future cosmonauts from India.

The history of Soviet-Indian cooperation in space lasting a decade is rich in remarkable events, Novikov said. The work to create the third Indian satellite now proceeds successfully with technical assistance of Soviet specialists. The satellite will be launched by a Soviet rocket booster from the USSR territory.

Soviet and Indian specialists studied thoroughly the questions connected with the modification of the previous satellite "Bhaskara," worked out a scientific program of experiments that will be implemented with another satellite meant for studying the earth's surface from space.

The entire scientific program of the second Indian satellite "Bhaskara," just as that of the first one, has been completed in the main. It included some important experiments connected with studies of X-ray emission from space. Valuable scientific data was received while the sputnik was in orbit. The results will be announced at a session of the International Committee on Space Research (COSPAR).

Besides that, Nikolay Novikov said, Soviet and Indian meteorological rockets for studying the upper layers of the atmosphere in low latitudes have been launched from the range in Tumba, India for many years.

[252-F]

VII. Launch Table (All launch data provided by Soviet news agency TASS)

Date	Designation	Orbital Parameters				Notes
		Apogee	Perigee	Period	Inclination	
20 Feb 80	Raduga	36,610 km		24 h 38 min	0.4°	Centimeter wave band communications; international registration index "Statsionar-2"
21 Feb 80	Cosmos-1165	379 km	182 km	89.8 min	72.9°	
4 Mar 80	Cosmos-1166	406 km	208 km	90.3 min	72.9°	
14 Mar 80	Cosmos-1167	457 km	433 km	93.3 min	65 °	
18 Mar 80	Cosmos-1168	1026 km	981 km	104.9 min	82.9°	

[254-P]
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USSR REPORT: Translations from KOMMUNIST*
USSR REPORT: PROBLEMS OF THE FAR EAST*
USSR REPORT: SOCIOLOGICAL STUDIES*
USSR REPORT: USA: ECONOMICS, POLITICS, IDEOLOGY*

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USSR REPORT: Life Sciences: Biomedical and Behavioral Sciences
USSR REPORT: Life Sciences: Effects of Nonionizing Electromagnetic Radiation
USSR REPORT: Life Sciences: Agrotechnology and Food Resources
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WORLDWIDE REPORT: Nuclear Development and Proliferation
WORLDWIDE REPORT: Telecommunications Policy, Research and Development

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